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and Teleophthalmology Project

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**ABSTRACT**

**NERVE FIBER LAYER ANALYSIS TELECONSULTATION**

Major Christopher S. Allen, Lieutenant Colonel Todd D. Hess, Major Jim H. Burden, Lieutenant Colonel Richard H. Birdsong, Department of Ophthalmology, Landstuhl Regional Medical Center, Germany

**Objective:** To test the efficacy and efficiency of transmitting digital nerve fiber layer analysis (Gdx) results via e-mail for teleconsultation.

**Methods:** Retrospective study using 30 random Gdx images from 30 eyes. The images were printed on regular 8.5 X 11 inch paper from the Gdx printer. Patient identifiers were removed and the paper image was scanned using a Hewlett Packard ScanJet ADF and saved as JPEG files on a personal computer. The 30 scanned image files were emailed to three military glaucoma consultants via the World Wide Web using Outlook. The 30 printed, paper images were mailed via United States Postal Service to each of the three consultants along with a questionnaire asking the glaucoma consultants to evaluate the quality of the emailed Gdx images compared to the original paper Gdx printouts.

**Results:** The Gdx images were easily printed out from the Gdx machine and scanned. It took less than 20 seconds to save a Gdx image as a JPEG file. It took less than 10 seconds to send the email message with the scanned Gdx attachments. Two of the three glaucoma specialists felt quality of emailed images where sufficient and would feel comfortable using them in place of the original image. .

**Conclusion:** Electronic transmission of Gdx images via email was easy and efficient. Two of the three glaucoma consultants felt the emailed Gdx images were of sufficient quality to use instead of the original hard copy. This method of consultation could prevent unnecessary air evacuations to CONUS saving thousands of dollars and hundreds of man-hours, however due to our patient population this benefit was not realized.

**BODY**

## Nerve Fiber Layer Analysis Teleconsultation

- Funding: FY01 \$75,400
- Funds used to purchase: Laser Diagnostic Technologies GDx Nerve Fiber Layer Analyzer
- MIPR # 1DCB8D1065

**Introduction:**

Telemedicine remains a very interesting area for military medicine, as with its implementation, specialist and subspecialist consultations at larger centers can be obtained for patients in remote areas without necessitating patient transport. The potential for savings and decreased mission down time are enormous. Very little is known, however, about the suitability of various types of images for transmission. This area is remains relatively uncharted in the medical literature.

GDx is an adjunctive instrument used in the diagnosis and management of glaucoma. It uses scanning laser light to measure nerve fiber layer thickness around optic nerve. Data is analyzed by the GDx computer and a print out on 8.5 in x 11 in paper generated. This information is useful in evaluating optic nerve for damage.

**Methods:**

This was a retrospective study using 30 random Gdx images from 30 eyes. The images were printed on regular 8.5 X 11 inch paper from the Gdx printer. Patient identifiers were removed and the paper image was scanned using a Hewlett Packard ScanJet ADF and saved as JPEG files on a personal computer. The 30 scanned image files were emailed to three military glaucoma consultants via the World Wide Web using Outlook. The 30 printed, paper images were mailed via United States Postal Service to each of the three consultants along with a questionnaire asking the glaucoma consultants to evaluate the quality of the emailed Gdx images compared to the original paper Gdx printouts.

**Results:**

The Gdx images were easily printed out from the Gdx machine and scanned. It took less than 20 seconds to save a Gdx image as a JPEG file. It took less than 10 seconds to send the email message with the scanned Gdx attachments. Two of the three glaucoma specialists felt quality of emailed images where sufficient and would feel comfortable using them in place of the original image. Listed below in table format are results for questions 1 thru 8 of the questionnaire. Raters BF, ED, and LF answered 8 questions for each of the 30 images. The mean score as well as range of scores are listed for each question by rater.

Rater	Ques 1 Mean (range)	Ques 2 Mean (range)	Ques 3 Mean (range)	Ques 4 Mean (range)	Ques 5 Mean (range)	Ques 6 Mean (range)	Ques 7 Mean (range)	Ques 8 Mean (range)
BF	1 (1-1)	6.1 (5-9)	5.7 (3-6)	8.9 (7-9)	8.9 (7-9)	7.8 (5-9)	9.0 (8-10)	8.9 (8,9)
ED	2.7 (2-7)	4.1 (2-6)	2.7 (1-4)	3.1 (2-4)	3.1 (2-8)	4.1 (2-7)	3.1 (1-7)	7.3 (2-9)
LF	1 (1-1)	8.6 (4-	8.4 (4-	9.2 (4-	9.17 (4-	9.3 (5-	9.2 (5-10)	10 (10-

## FY01 AMEDD TELEHEALTH INITIATIVE FINAL REPORT

		10)	10)	10)	10)	10)		10)

### • **Cost of care pillar:**

Potential for cost savings by preventing unnecessary air evacuations by giving CONUS glaucoma specialists pertinent visual data with which to render opinion.

### • **Access to care pillar:**

Tremendous potential increase in access of patient data to subspecialty consultation only available at major medical centers

### • **Quality of care pillar:**

Dramatic potential for increased quality by allowing rapid consultation with sub specialists not available in theatre

### • **Problems encountered:**

1. Due to the relatively healthy young population with relatively uncomplicated glaucoma our clinic does not generate a sufficient number of abnormal Gdx Studies to supply an adequate N for statistical study. We could not evaluate actual cost savings since no glaucoma patients were severe enough to require air evacuation for higher level care.

2. We did not take delivery of GDx device until March 2001 delaying start of study.

3. There was a significant delay in starting the study due to IRB/human use approval process which resulted in the decision to use pre-existing data to meet reporting timelines.

3. The OPSTEMPO of LRMC with OEF workload in addition to Warfighter Refractive Surgery Program start-up limited time for the telemedicine study

4. The neuro-ophthalmologist at LRMC interested in using GDx for teleconsultation PCS'd prior to study beginning limiting eligible patients

### **AMEDD applicability:**

This study showed efficacy but limited usefulness in European theatre due to low incidence of glaucoma. This device could be very useful in a rural area with a large, elderly, retiree population with a higher incidence glaucoma without access to glaucoma specialist

### **CONCLUSIONS:**

Electronic transmission of Gdx images via email was easy and efficient. This technology has potential to prevent unnecessary air evacuations to CONUS saving thousands of dollars and hundreds of man-hours. Due to the limitations described above this potential was unrecognized and will likely remain so. We would not recommend the Gdx for AMEDD wide adoption. We recommend leaving the decision up to individual clinics based on local need.

### **KEY RESEARCH ACCOMPLISHMENTS**

We determined that the Gdx images could be sent efficiently with good quality via the internet from Europe to CONUS.

Two of the three glaucoma specialists felt quality of emailed images where sufficient and would feel comfortable using them in place of the original image.

We determined that due to patient population statistics in our catchment area that the Gdx technology is not as useful as it might be in other situations.

### **REPORTABLE OUTCOMES**

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Electronic transmission of Gdx images via email was easy and efficient. This technology has potential to prevent unnecessary air evacuations to CONUS saving thousands of dollars and hundreds of man-hours. Due to the limitations described above this potential was unrecognized and will likely remain so. We would not recommend the Gdx for AMEDD wide adoption. We recommend leaving the decision up to individual clinics based on local need.

**APPENDIX A: TECHNICAL SUMMARY**

Laser Diagnostic Technologies GDx Nerve Fiber Layer Analyzer was instrument used for the study.

Print outs of GDx analysis were scanned using a Hewlett Packard ScanJet ADF and saved as JPEG files on a personal computer.

JPEG files were emailed using outlook from ophthalmology clinic personal computer

**APPENDIX B: FUNDED PERSONNEL AND PARTICIPANTS**

PI: Todd Hess

Assistant PI and executer of study: Christopher S. Allen

Glaucoma specialists:

Erin Doe

Lilia Fanin

William Flynn

**APPENDIX C: SUPPORTING DOCUMENTATION**

**Gdx (nerve fiber layer analysis) Study Questionnaire  
Part One**

After opening the attached Gdx image file from the Internet answer the questions below.  
Please note the Gdx ID # (found top center of printout) here \_\_\_\_\_.

1) How long did it take you to open the file (from the time you clicked on the attachment to the time the image appeared on your screen for review). Please pick a number between 1 and 7.

1) 1-5 seconds. --- 2) 6-15 seconds ---- 3) 16- 30 seconds --- 4) 31- 60 seconds.---  
5) 61 – 180 seconds-----6) greater than 181 seconds (3 minutes)-----7) could not open file.

After reviewing the electronically transmitted Gdx image please answer the questions below. (This is done prior to reviewing the original Gdx printout)

2) How would you rate the quality of the “scanning laser image of the disc” (top left image) of the transmitted Gdx printout on a scale of 1 to 10 (1 being poor quality and 10 being very good quality). Quality is defined as ability to distinguish the necessary clinical information from the picture to have it be useful in clinical practice.

1-----2-----3-----4-----5-----6-----7-----8-----9----10

3) How would you rate the quality of the “retinal nerve fiber layer analysis image” (top right image) of the transmitted Gdx printout on a scale of 1 to 10 (1 being poor quality and 10 being very good quality). Quality is defined as ability to distinguish the necessary clinical information from the picture to have it be useful in clinical practice.

1-----2-----3-----4-----5-----6-----7-----8-----9----10

4) How would you rate the overall quality of the electronically transmitted Gdx printout (the entire printout) on a scale of 1 to 10 (1 being poor quality and 10 being very good quality). Quality is defined as the ability to distinguish the necessary clinical information from the entire electronically transmitted Gdx printout to have it be useful in clinical practice.

1-----2-----3-----4-----5-----6-----7-----8-----9----10

**Gdx (nerve fiber layer analysis) Study Questionnaire**

**PART TWO**

Now compare the electronically transmitted Gdx printout to the original Gdx printout and answer the questions below. Please ensure the number identifier of the original matched the number identifier of the e-mailed version.

5) How would you rate the quality of the "scanning laser image of the disc and peripapillary area" on the electronically transmitted Gdx printout compared to the original Gdx printout on a scale of 1 to 10 (1 being poor quality and 10 being very good quality). Quality is defined as ability to distinguish the necessary clinical information from the picture to have it be useful in clinical practice.

1-----2-----3-----4-----5-----6-----7-----8-----9-----10

6) How would you rate the overall quality of the electronically transmitted Gdx printout compared to the original on a scale of 1 to 10 (1 being poor quality and 10 being very good quality). Quality is defined as ability to distinguish the necessary clinical information from the picture to have it be useful in clinical practice.

1-----2-----3-----4-----5-----6-----7-----8-----9-----10

7) How would you rate your confidence in being able to use the electronically transmitted Gdx printout instead of the original Gdx printout in clinical practice on a scale of 1 to 10 (1 being not confident at all and 10 being very confident).

1-----2-----3-----4-----5-----6-----7-----8-----9-----10

8) How would you rate the overall efficiency (ease of use) of receiving and opening the Gdx e-mail attachments on a scale of 1 to 10 (1 being very cumbersome and difficult to use and 10 being easy to use).

1-----2-----3-----4-----5-----6-----7-----8-----9-----10

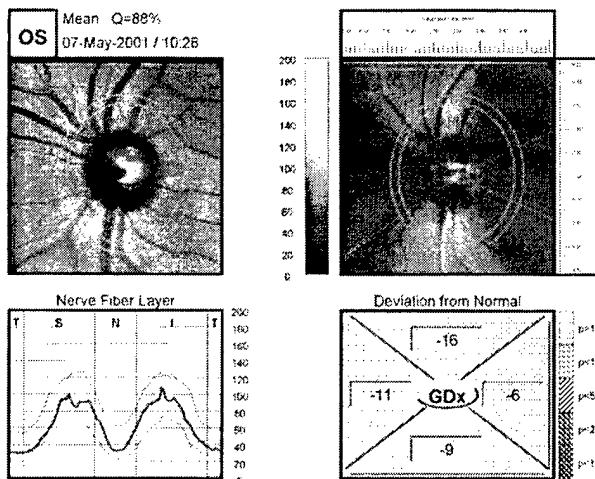
# Example of Gdx image

GDx® Nerve Fiber Analyzer Extended Analysis

LRMC Dept. of Ophthalmology  
CAIR 402  
APC-AE 50180  
000 00371 NA 8190 DSN 400 8190

Age: 23 Gender: Female, Race: Black

Print Date: 28-Aug-2001



## NERVE FIBER ANALYSIS

	Alt. Value	Status	Probability		Alt. Value	Status	Probability
Superior	0.54	Within Normal		Thin Nerve	17		
Inferior	2.41	Within Normal		Anterior To Arcs	57	Within Normal	
Temporal	2.55	Within Normal		Superior Arc Length	64	Within Normal	
Superior Arc	2.54	Within Normal		Inferior Arc Length	63	Within Normal	
Max. Asymmetry	1.65	Within Normal		Superior Arc Length	74	Within Normal	
Superior Arc Length	2.64	Within Normal		Superior Arc Length	0.20	Within Normal	

Comment

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**APPENDIX D: PRESENTATIONS, POSTERS, PUBLICATIONS**

Power point presentation for final report in California as well as for Air Force Clinical Surgeon's Meeting in Las Vegas. The powerpoint presentation is available via email with graphics. Mr. Winston has copy of presentation.